

(d) recovering lactic acid or products thereof from said lactate salt in a portion of said lactic acid-depleted aqueous solution by a method comprising extraction with a basic extractant, substantially as obtained in step (c), to form lactic acid-containing extractant.

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**REMARKS**

The Official Action of October 25, 2000 has been carefully considered and reconsideration of the application as amended is respectfully requested.

Claims 1 - 18 have been cancelled and replaced by new claims 19 - 34. Claim 19 corresponds to original claim 1 except that text that was inadvertently omitted from step (a) has been inserted thereinto and the objectionable language "by means known per se" has been deleted from step (c). The newly added dependent claims contain recitations that were formerly in the original dependent claims. The newly added claims avoid the use of the phrase to which the Examiner objects in paragraph 1 of the Official Action, and the claims are otherwise believed to be sufficiently definite to satisfy the dictates of 35 USC 112, second paragraph.

The claims have been rejected under 35 USC 103(a) as allegedly being unpatentable over Baniel et al. Applicants respectfully traverse this rejection.

As noted by the Examiner, Baniel et al disclose a process for the recovery of lactic acid from a lactate solution composed of sodium lactate, calcium lactate or potassium lactate. The Examiner has acknowledged that the claimed invention differs from Baniel et al by stating that, in Baniel et al, "the ratio between free lactic acid and lactate salt is not mentioned". Indeed,

Baniel et al not only do not mention a ratio between free lactic acid and lactate salt, they do not mention the presence of any specified amount of free lactic acid in their fermentation broth at all (see, e.g., Baniel et al at column 1, lines 49 - 51: "This results in the formation of a lactate solution rather than the desired lactic acid product."). This being the case, it is respectfully submitted that Baniel et al cannot be used to set forth even a *prima facie* case for alleged obviousness of the claimed invention which requires extraction from an aqueous solution containing free lactic acid (all claims) and/or extraction from an aqueous solution containing free lactic acid in a defined amount (see, e.g., claims 20, 21 and 23).

Although the Examiner has acknowledged Baniel et al's failure to mention a ratio between free lactic acid and lactate salt, he contends that it would have been obvious to optimize reaction conditions including the manipulation of a ratio between fat free lactic acid and lactate salt, and has cited in *In re Aller* for this proposition. However, Applicants respectfully note that the decision in *In re Aller* applies only where the general conditions of a claim are disclosed in the prior art (not the case here). Moreover, as discussed in MPEP Section 2144.05(B), a particular parameter must first be recognized as a result-effective variable, i.e., a variable which achieves a recognized result, before the determination of the optimum or workable ranges of such variable might be characterized as routine experimentation. In the present case, as discussed above, Baniel does not even consider the presence of free lactic acid in the fermentation broth to be a variable much less a result-effective variable. The claimed invention deals with a fermentation broth other than that dealt with by Baniel. The broth according to the Baniel patent is primarily one of lactate salt as can be realized from the fact that a fermentation broth at a pH in the range of 5.5 is composed of about 98% salt and 2% free acid while a broth in the range of 6.5 has an even greater salt to acid ratio.

In view of the above, it is clear that changing the composition of the Baniel et al fermentation broth is not merely an optimization of conditions taught by the prior art. Accordingly, Baniel et al cannot be considered to set forth even a *prima facie* case for alleged obviousness of the invention as claimed. Moreover, even assuming for the sake of argument that Baniel et al taught that the presence or concentration of free lactic acid in a fermentation broth were a variable that could be optimized, Applicants have provided evidence of unexpected results that would be sufficient to overcome any alleged *prima facie* case of obviousness based upon Baniel. In this regard, Applicants respectfully call the Examiner's attention to Examples 1 - 4 in the specification which show that the claimed process is effective for the recovery of lactic acid from aqueous solutions containing sodium lactate and lactic acid in the claimed ratios. These results are not shown or suggested by Baniel et al and must be considered to be unexpected.

Thus, as stated on page 5 of the specification: "It would not be expected that free lactic acid could be extracted efficiently from the lactate salt-containing broth by an amine-based extractant, due to the buffering effect of the salt. Amines extract acids through ion-pair formation and should therefore be positively charged. In the case of primary, secondary and tertiary amines (quaternary ones are not suitable for reversible extraction), the formation of the required positive charge is by binding protons (protonation) from the aqueous solution. Extraction efficiency is therefore determined by the availability of protons in the aqueous solution. Thus, extraction of the free lactic acid is strongly dependent on the concentration of the lactate salts in the solution:

$$[H] = K_a[HLa]/[La]$$

where  $[H]$ ,  $[HLa]$  and  $[La]$  denote the concentration of protons, undissociated lactic acid and lactate ions, respectively, and  $K_a$  is the dissociation constant of lactic acid. A significant lactate salt to free lactic acid ratio, or low free acid to salt ratio, substantially decreases the ratio  $[HLa]/[La]$  and thereby decreases the availability of protons in the aqueous solution and the protonation of the amine. Therefore, the efficiency of extraction of the free lactic acid is expected to be low. It would be even lower, if the extractant already contains lactic acid from a previous stage."

Similarly, as stated in the first paragraph of page 7 of the specification:

"With the above state of the art in mind, it has now been surprisingly found that a basic extractant is capable of extracting most of the free acid from a fermentation liquor, even if the free lactic acid to lactate salt ratio in it is lower than 1:3. Furthermore, high yield of extraction was found, even with an extractant that comprises lactic acid from a previous step."

The above features of the claimed invention are clearly not taught or suggested by Baniel and also are not the result of adjustment of ratios as suggested by the examiner.

Furthermore, the advantages achieved by the claimed invention are clearly not obvious from or suggested by Baniel who was dealing with a broth which was almost completely salt.

Thus, as stated e.g., on page 9 of the specification:

"The advantages of the process of the preferred embodiment of the invention include the

following: (1) recovery of lactate values from the free acid fraction and salt-splitting are effected by LLE, which ensures high recovery yields, high purity, and relatively high product concentrations; (2) there is no need to operate two separate extraction cycles; (3) the stripped extractant, which has the strongest extraction power, is utilized where the strong extraction power is mostly needed, i.e., for the salt-splitting; (4) the surprising finding that even a partially loaded extractant is capable of efficient extraction of the free lactic acid in the presence of lactate salt is best utilized; and (5) an extract containing lactic acid from both the free lactic acid and the salt-splitting is fed to the stripping operation in an overall high concentration, so that the concentration of the back-extract is high. Such high concentrations of back-extract are not attainable by operating the salt-splitting separately and stripping at the same conditions. Neither can they be obtained by operating the salt-splitting and the recovery of the free acid in two separate cycles and mixing the extract for back-extraction, nor by back-extracting them separately and mixing the back-extracts."

Similarly, as stated on page 11 of the specification:

"It would have been expected that adjustment of the extractant composition would be needed in process 3 above, e.g., by adding enhancer to the extractant after stripping and prior to the salt-splitting operation, and removing some enhancer prior to the extraction of the free lactic acid. It was surprisingly found that such an adjustment is not necessary."

Thus it is clear that Baniel neither teaches nor suggests the presently claimed process or the advantages thereof when dealing with the recovery of lactate acid from an aqueous solution containing free lactic acid and a lactate salt as taught for the first time in the present specification.

Moreover, the results that can be achieved with the claimed process could not have been expected from Baniel.

In view of the above, all rejections and objections of record are believed to have been successfully traversed and the application is believed to be in allowable form. An early Notice of Allowability is earnestly solicited and is believed to be fully warranted.

Respectfully submitted,

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